Hospital Costs and Long Term Mortality Outcomes in Seniors Requiring Hospitalization for Community-Acquired Pneumonia in Alberta

By: Yan Jin, M.A. [1]
Thomas J. Marrie, M.D. [2]
Keumhee C. Carrière, Ph.D. [3]
Gerry Predy, M.D. [4]
Chris Houston, CCRHA(C) [4]
Kathleen Ness, M.P.H. [4]
David Johnson, M.D., S.M., M.B.A. [5, 6]

[1] Alberta Health and Wellness, Research and Evidence Branch
[2] University of Alberta, Department of Medicine
[3] University of Alberta, Department of Mathematics
[4] Capital Health Authority
[5] Alberta Centre for Health Services Utilization Research
[6] University of Alberta, Department of Critical Care Medicine

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For additional information, contact:

David Johnson, M.D., S.M., M.B.A.
Department of Critical Care Medicine
Faculty of Medicine
University of Alberta
Edmonton, Alberta
T6G 2B7
E-mail: cujecjohnson@shaw.ca
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SUMMARY

We describe the variations by age in outcomes (death and hospital costs) and special medical care provided for Alberta patients hospitalized with community-acquired pneumonia. Special medical care is defined as transfer of an admitted patient to another acute care hospital, special or intensive care unit admission, use of a breathing machine for greater than ninety-six hours, or in-hospital dialysis. Hospital discharges for community-acquired pneumonia from April 1,1994 to March 31, 1999 were analyzed using Alberta hospital abstracts and vital statistics. There were 8,500 annual hospital discharges for community-acquired pneumonia costing over forty million dollars per year. The overall in-hospital mortality rate was twelve percent and the one-year mortality rate was twenty-six percent. The mean age of pneumonia cases increased from 62.8 years in 1994/95 to 67.2 years in 1998/99. The proportion of hospital discharges in those aged eighty-five years and over was thirteen percent in 1994/95 increasing to eighteen percent in 1998/99. The age-specific hospital discharge rate and length of hospitalization increased with age. After adjustment for other factors, the relative risk of both in-hospital and one-year mortality increased with age; the relative risk for the use of special medical care and average daily hospital costs decreased with age. The increased total costs of about $1,000 per hospital stay in those aged over eighty-five compared to those eighteen to forty-four years of age, is consistent with competing costs due to their increased length of stay and reduced use of special medical care. The anticipated marked increase in use of hospital resources because of an aging population may have been partially avoided because of the limitation of rendered therapy in the "old and frail". Age-specific utilization rather than aging itself is a more important determinant of age-related increases in health expenditures. If the historical pattern of medical care choices continue, the anticipated increase in hospital costs for pneumonia care due to an aging population may be somewhat offset by the decreased utilization of special medical care in these oldest patients. However, choices about appropriate medical care vary over time, and, in future, an increased utilization of special medical care may occur in even the oldest patients.

INTRODUCTION

Aging of the population presents a challenge to policy makers and health care professionals charged with ensuring the delivery of comprehensive, high quality programs and services to older persons over the coming decades. Alberta has a relatively low proportion of persons aged over sixty-five years (9.3 percent in 1993 compared to 11.7 percent in Canada and 12.7 percent in the United States) [1]. The mean annual population growth in Alberta since 1990/91 has been one percent in those less than sixty-five years and three percent in those aged sixty-five and over [2]. The projected proportion of those aged sixty-five and over in Alberta will be 13.5 percent in 2016 [3]. The proportional increase in Alberta seniors will have a magnified affect upon hospital utilization as the overall hospital inpatient discharge rate increases by age (i.e. in 1997/98: ninety-four per 1,000 population in those less than sixty-five, two hundred and six per 1,000 population in those sixty-five to seventy-four, three hundred and eighty-two per 1,000 population in those seventy-five to eighty-four, and five hundred and thirty-two per 1,000 population in those eighty-five and over) [2]. The variation in medical services provided and hospital costs for different age groups is not well described.

In this study we describe the age-related hospital utilization and outcomes for one disease, community-acquired pneumonia. Community-acquired pneumonia is a suitable disease for a utilization study as it is a common reason for hospital admission with an annual incidence of twelve per 1,000 adults in which approximately fifteen percent of cases are admitted to hospital [4, 5]. As well, hospitalization consumes up to ninety percent of direct medical costs of treating this condition and the thirty-day mortality of those hospitalized is fifteen percent [6-9]. This study specifically investigates the costs, medical services provided, and mortality outcomes for seniors compared to non-seniors for community-acquired pneumonia in one Canadian province.

METHODS

Inclusion Criteria:

Community-acquired pneumonia was defined as the most responsible diagnosis or any of the other fifteen diagnosis codes defined to be Type 1 (pre-admit comorbidity) with the ICD-9-CM values of 480.x to 487.x (pneumonia) or 507.x (aspiration pneumonia) excluding 484.x (pneumonia of infectious diseases classified elsewhere) [10, 11].

Exclusion Criteria:

1. Not an Alberta resident or not treated in an Alberta acute care facility
2. Adjacent diagnosis related group defining hospitalization for a surgical procedure
3. Any previous hospitalization within ten days of incident pneumonia case

Special medical care provided defined as:

- Transfer of an admitted patient to another acute care hospital (attending physician determined)
- Special/intensive care unit admission (individual hospital defined facility)
- Mechanical ventilation greater than ninety-six hours (Procedure code ICD-9-CM 96.72)
- In-hospital dialysis (Procedure code ICD-9-CM 39.95, 54.98)

Comorbidity:

Charlson's comorbidity index was calculated using established definitions [12, 13]. Length of stay was calculated as days between discharge and admission date. Alternate (not acute care) level of care days were subtracted from the length of stay. Transfers were attributed to the index admission and cumulative hospital length of stay calculated. Transfer from another acute care facility was defined by re-admission to hospital for the diagnosis of pneumonia within two days of previous discharge. Transfer from a nursing home was defined as transfer to hospital from a nursing home, long term care or continuing care institution. All active hospital acute care beds in each year per resident region were surveyed and maintained in the provincial databases. Aboriginals registered with the Department of

Indian Affairs and Northern Development are recorded within the Alberta Health Care Premium Registry databank. Export was primary admission to a hospital not within region of residence.

Defining Hospital Volume:

All hospitals in Alberta are administered by an autonomous regional board in each of the seventeen health regions. All residents of Alberta enrolled in the public health care insurance plan reside in one of the seventeen health regions. Hospitals admitting patients with community-acquired pneumonia were categorized into five groups on the basis of the average number of separations per year over the five year study period, geographic location, and medical school proximity:

Rural

- Less than 50 cases per year in seventy-seven hospitals;
- 50 to 108 cases per year in twenty-seven hospitals;

The rural hospital cutoff values for pneumonia cases of 50 and 108 represented the 50^{th} and 75^{th} percentiles of the volume of pneumonia cases in all Alberta patients.

Regional

- Five hospitals located in one of the five non-metropolitan regional health care cities ranging from 67 to 251 cases per year and one high volume rural hospital accounting for 221 cases per year;

Metropolitan

- Seven hospitals located in the metropolitan health regions of Calgary and Capital hospitals ranging from 92 to 813 cases per year;
- Two hospitals located adjacent to medical schools with one hospital located in each of two metropolitan centres ranging from 493 to 610 cases per year.

Hospital Costs:

In-patient costing per resource group number was calculated using the provincially approved methodology as set forth by the Provincial Costing Project and in accordance with the Provincial and National Management Information Systems guidelines [14, 15]. Total costs combine allocation and assignment of all direct and indirect costs associated with an in-patient

encounter from the time a patient is admitted to the hospital to the time they are discharged. All costs were estimated in 1998/99 and assumed similar for all the study years. The quality of the data reporting of costs in Alberta has been highly ranked by the Canadian Institutes for Health Information [16]. As such, the methodological issues that arise around collection of cost data in the United States [17], in part due to the use of prices rather than costs, and for centres in Canada which cost admissions on the basis of "case-mix grouping", do not arise with the majority of the cost data considered in this analysis.

Mortality:

Vital statistics declaration of death certificates were merged with the Alberta Health Care Premium Registry databank in order to determine de-registration from the plan. Reliability of linkage was high (99.5 percent) as verified by comparing in-hospital deaths recorded by hospital chart extraction to Alberta Health Care Premium Registry death derived from vital statistics. In the analysis of the 1994/95 pneumonia cohort, only those registered in each of the four study years were analyzed (about ninety-five percent). A general population cohort was constructed from:

1) all those registered with the Alberta Health Care Premium Medical Insurance Plan between April 1, 1994 to March 31, 1995;
2) those aged eighteen years and over on March 31, 1995;
3) those who had not been hospitalized for pneumonia during 1994/95.

The subsequent mortality status of 8.5 percent of the general population cohort could not be ascertained requiring their removal from the analysis, as they were not continuously enrolled the Alberta Health Care Premium Medical Insurance Plan during each of the four study years.

Outcomes Used in Regressions:

- Daily hospital cost per separation;
- Incidence of special medical care per separation (any one or more of transfer to another hospital, special care unit admission, mechanical ventilation for ninety-six or more hours [ICD-9-CM 96.72] or in-hospital dialysis [ICD-9-CM 39.95, 54.98]);
- In-hospital mortality per patient or per separation;
- One-year mortality per patient or per separation.

Note that for one-year mortality regressions only those discharged alive from hospital were analyzed.

STATISTICS

Age-specific separation rates were calculated using the 1998/99 provincial population. Age at the fiscal year-end is used for the rates. One-year age-sex specific mortality rates were compared using the T-statistic [18] while adjusting for multiple comparisons. Four-year age-sex specific mortality for patients with separations during 1994/95 was compared using the T-statistic to that of the Alberta population in the corresponding age group. If the overall T-statistic was significant, individual rate differences were compared. A forward stepwise selection of factors (SAS 8) was used to determine the order of importance of the factors influencing each outcome variable. Covariates were age (18-44, 45-64, 65-74, 75-84, 85+), sex, year of separation, per capita number of acute care beds per resident region in each study year, hospital type as defined above, exported case (i.e. service region not equal to recipient region), urban or non-urban resident region, aboriginal treaty status, nursing home transfer to hospital, diagnosis code of respiratory failure/arrest (ICD-9-CM 518.81, 799.1), diagnosis code of hypotension/shock (ICD-9-CM 458.xx, 758.5x), and number of comorbid diagnosis (0, 1, 2, >2). The unit of analysis was hospital separation with some patients being hospitalized on multiple occasions per year. We attempted to adjust for correlations in separations within the same subject, but it did not result in substantial difference from those under the assumption of zero correlation. Therefore, we opted to report results of a simpler approach based on multiple linear and logistic models [19, 20]. To control the large sample size effect on statistical significance, we used one-third random sample from the separations data for statistical modeling [21]. The results were validated with the entire data to test for bias in the sample. Data was analyzed using the program SAS 8 [SAS Institute Inc. Cary, NC 2000] and significance was defined as $p < 0.05$.

RESULTS

During the five years of the study there were 43,642 acute care hospital separations for 36,516 unique patients. About fifteen percent of the patients (n = 4,935) had repeated admissions during the five years (separations/patient: mean 1.26; median 1; range 1 to 16). The absolute number of hospital separations decreased in 1995/96 compared to 1994/95 (9,141 to 7,726) and gradually increased to 9,366 in 1998/99 (the last year of our study).

The description of pneumonia cases by age-specific group is found in Table 1. The age-specific separation rate, percent comorbidity, transfer from nursing home, and length of hospitalization increased with age. The age-specific separation rates were significantly lower in all groups when compared to the eighty-five and over age group. Those patients less than sixty-five years were less likely to reside in one of the two Alberta metropolitan cities. Special medical care (transfer to another hospital, admission to a special care unit, ventilation for greater than ninety-six hours, and in-hospital dialysis) occurred mostly in those aged eighty-four years or less. Indeed, the rate of special medical services showed a marked drop for those in the eighty-five years and over age group (Tables 1 and 2).

Both in-hospital and one-year mortality increased with advancing age. Figure 1 demonstrates the one-year survival by monthly intervals after hospitalization for pneumonia in each age-specific group. Mortality in each age-specific group was significantly different from all other groups ($p < 0.0001$). Figure 2 demonstrates the four-year mortality for those patients hospitalized for pneumonia in the year 1994/95 (n = 9,141) who were followed for four subsequent years. The mortality for those hospitalized for pneumonia in each age-specific group was greater than that of the 1994/95 Alberta general population not hospitalized with pneumonia (n = 1,950,997) followed longitudinally for the same duration of time. The significant difference in mortality rates between the pneumonia and non-pneumonia groups is mainly due to the sharp drop in the survival probability of pneumonia patients during the first year ($p < 0.0001$). The difference in mortality rate for those who were hospitalized with pneumonia without comorbidity (these data not illustrated) is still greater than that of the general population in all age groups ($p < 0.0001$).

Figure 3 demonstrates the age-specific percent composition of total hospital separations in each study year. The demographics of hospital separations demonstrated an increase for those in the oldest group (eighty-five years and over) and decrease for those in the youngest group (eighteen to

forty-four years). The mean age of pneumonia cases increased from 62.8 years in 1994/95 to 67.2 years in 1998/99 ($p < 0.000$). The proportion of hospital separations in those eighty-five years and over was thirteen percent in 1994/95 increasing to eighteen percent in 1998/99 ($p < 0.000$). After adjustment for other factors (see regression methods above), the relative risk of both in-hospital and one-year mortality increased with age (Tables 3 and 4). In general, advancing age and multiple comorbidities increased the odds of one-year mortality.

The relative risk for the use of special medical care and average daily hospital costs decreased with age (Tables 5 and 6) after adjusting for other factors (see regression methods above). Although the cost per day and the use of special medical care resources were significantly lower among those aged eighty-five or more years of age, their total cost per hospital stay was about $1,000 more compared to those aged eighteen to forty-four years. This was consistent with increased costs associated with an increased length of stay and reduced use of special medical care.

DISCUSSION

We found that community-acquired pneumonia was a common cause for hospital admission in Alberta with an annual hospitalization rate of four cases per 1,000 accounting for 8,500 annual hospital separations at a cost of over forty million dollars per year. The overall in-hospital mortality rate was twelve percent and one-year mortality rate was twenty-six percent, which is greater than the expected age-specific mortality rate for the population [3]. The difference in mortality rates between the pneumonia and non-pneumonia groups was mainly due to the sharp drop in survival rate that occurred during the first year. After the first year, the risk of death remains similar between the two groups for all ages. As expected, mortality and comorbidity generally increased with age. Length of hospital stay also increased with age. In contrast, use of special medical care (transfer to another hospital, admission to a special/intensive care unit, ventilation for greater than ninety-six hours, and in-hospital dialysis) and daily cost per case was least in the oldest group after accounting for comorbidity and normalizing for length of stay. Although patients eighty-five years of age and older constitute an increasing proportion of in-hospital pneumonia cases, the decreased utilization of special medical care is consistent with lower daily costs in the oldest age groups. The anticipated markedly increased demand upon hospital resources because of an aging population may have been partially avoided because of the limitation of extraordinary therapy such as mechanical ventilation [22].

The greatest morbidity burden for pneumonia falls disproportionately on the elderly [23]. Mortality due to pneumonia has not declined in recent years with rates between fifteen to twenty percent [24, 25] and much higher rates in the elderly [26]. Similar to others, we found that community-acquired pneumonia, with or without comorbidity, is a risk factor for long term (up to four years) mortality [27]. Using administrative data, others have noted in-hospital mortality rates similar to those found in this study. These rates were higher in seniors (10.7 percent) compared to those less than sixty-five years (5.3 percent) [28]. Population data provides a more robust estimate of mortality compared to clinical trials, which restrict cases based upon varying inclusion and exclusion criteria. Length of hospital stay and comorbidity increased with age. A prior study noted that physicians may delay discharge in clinically stable patients because of comorbid illnesses [29]. However, we found that the increase in comorbidity was not associated with an increase in hospital costs. Yet, a lower rate of special medical care utilization was noted with advancing age. These results may seem counter-intuitive, but patients or their physicians may choose different medical care based upon age or debilitating comorbidity. Other retrospective studies, using United States administrative data sets, have demonstrated greater overall hospital costs in seniors (sixty-five and older) but not by specific age groups of seniors [30-32]. Hospitalization costs per elderly patient in the United States are US $5,942 [33]. Comparisons to Canadian costs are difficult as both currency conversion and dollar purchase parity have to be considered.

Our study has several limitations. Population-based administrative database research is highly generalizable although limited in clinical details. We attempted to adjust for case severity (hypotension/shock, respiratory arrest/failure) and case mix (comorbidity, transfer from nursing home, age, and sex), but may not have captured all variation [34]. These variables are likely less reliable than a clinically derived pneumonia index [5]. Processes of care variables such as use of a special/intensive care unit or transfer to another hospital are not justified by a specific threshold in severity of illness or special care provided. As such, these variables would be expected to vary widely between patients and hospitals. Approximately five percent of the 1994/95 pneumonia patients and nine percent of population cohort were not registered with the Alberta Health Care Insurance plan during each of the four study years. Although the mortality status of those non-registered in later years was not ascertained, their age and sex distribution was similar to that of those remaining.

Canada spent the highest proportion of total health expenditures on seniors (48.9 percent) in 1993 compared to eleven other Organization for Economic Co-operation and Development countries. Alberta was close to the per capita expenditure of other Canadian provinces [1]. The average compounded

growth in real provincial health expenditures solely due to population aging was 0.7 percent between 1980 and 1994. The average annual growth rate for total health expenditures in Alberta during the same time period was 2.1 percent [1]. Age-specific utilization, rather than aging itself, is a more important determinant of age-related increases in health expenditures [22]. If the historical pattern of medical care choices continue, the anticipated increase in hospital costs for pneumonia care due to an aging population may be somewhat offset by the decreased utilization of special medical care in these oldest patients [35]. However, choices about appropriate medical care vary over time and, in future, an increased utilization of special medical care may occur for even the oldest patients with pneumonia. Such trends of increased utilization of health care services in an older population have already been noted for renal dialysis, organ transplantation, and coronary artery bypass surgery [36, 37].

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FIGURE LEGEND

Figure 1

One-year survival curves by age cohort for all pneumonia patients admitted to hospital from April 1, 1994 to March 31, 1999

Figure 2

Four-year survival for incident pneumonia cases during 1994/95 only compared to age-specific general Alberta population

Figure 3

Yearly composition of total hospital separations by age-specific group

Table 1 – Age-specific utilization (number and percent) of acute care hospitals for community-acquired pneumonia in Alberta

	Ages 18 - 44	Ages 45 - 64	Ages 65 - 74	Ages 75 - 84	Ages 85 +	All Ages
Age-specific hospital pneumonia separation rate per 1,000 population	1.33*	3.12*	10.84*	26.03*	51.59	4.31
All separations	8,058 (18)	8,441 (19)	8,664 (20)	11,412 (26)	7,067 (16)	43,642 (100)
Length of hospital stay [mean(median)] in days	5.31* (4)	7.67* (5)	9.91* (6)	10.68* (7)	11.92 (8)	9.15 (6)
Exported from home region	1,406 (18)	1,249 (15)	941 (11)	1,,048 (9.2)	603 (8.5)	5,247 (12)
Urban region of residence	2,980 (37)	3,445 (41)	3,873 (45)	5,080 (45)	3,055 (43)	18,433 (42)
Comorbidity = 0	5,993 (74)	3,686 (44)	2,228 (26)	2,614 (23)	1,795 (25)	16,316 (37)
Comorbidity = 1	1,741 (22)	2,976 (35)	3,385 (39)	4,129 (36)	2,474 (35)	14,705 (34)
Comorbidity = 2	264 (3.3)	1,238 (15)	1,930 (22)	2,795 (25)	1,710 (24)	7,937 (18)
Comorbidity > 2	60 (0.7)	541 (6.4)	1,121 (13)	1,874 (16)	1,088 (15)	4,684 (11)
Transfer from nursing home	26* (0.3)	104* (1.2)	229* (2.6)	575* (5.0)	597 (8.5)	1,531 (3.5)
SPECIAL MEDICAL CARE						
Transfer to another hospital	173 (2.2)	219 (2.6)	219 (2.5)	234 (2.1)	98 (1.4)	943 (2.2)
Special care unit admission	570 (7.1)	870 (10.3)	887 (10.2)	944 (8.3)	307 (4.3)	3,578 (8)
Mechanical ventilation greater than 96 hours	133 (1.7)	168 (2.0)	148 (1.7)	134 (1.2)	34 (0.48)	617 (1.4)
In-hospital dialysis	69 (0.86)	88 (1.0)	57 (0.66)	61 (0.53)	7 (0.10)	282 (0.65)

* Denotes selected significant differences for any specific age group compared to the 85 and over age group corrected for multiple comparisons.

Table 2 – Age-specific outcomes (number and percent) for community-acquired pneumonia in Alberta

	Age 18 – 44	Age 45 – 64	Age 65 – 74	Age 75 – 84	Age 85 and over	All ages
In-hospital mortality	182 (3.9)	571 (12.2)	910 (19.4)	1,590 (33.9)	1,440 (30.7)	4,693 (100)
Age-specific mortality rate (%) per separation	2.3	6.8	10.5	13.9	20.4	10.8
One-year mortality for pneumonia separations	461 (4.1)	1,508 (13.3)	2,359 (20.8)	3,877 (34.1)	3,165 (27.8)	4,693 (100)
Age-specific one-year mortality rate (%) per separation	5.7	17.9	27.2	34.0	44.8	26.1
Special medical care	755 (16.5)	1,112 (24.3)	1,113 (24.3)	1,194 (26.0)	411 (9.0)	4,585 (100)
Total special care per rate (%) separation	9.4	13.2	12.9	10.5	5.8	10.5
Average costs in dollars per separation	$3,641	$4,478	$4,832	$4,807	$4,711	$4,518
Average cost in dollars per day	$685	$584	$488	$450	$395	$494

The number and percent constitute the distribution of the outcome in each age-specific group. The rate is the percent outcome for all cases within the specific age group

Figure 1 – One-year survival curves by age cohort for all patients hospitalized for pneumonia from April 1, 1994 to March 31, 1999

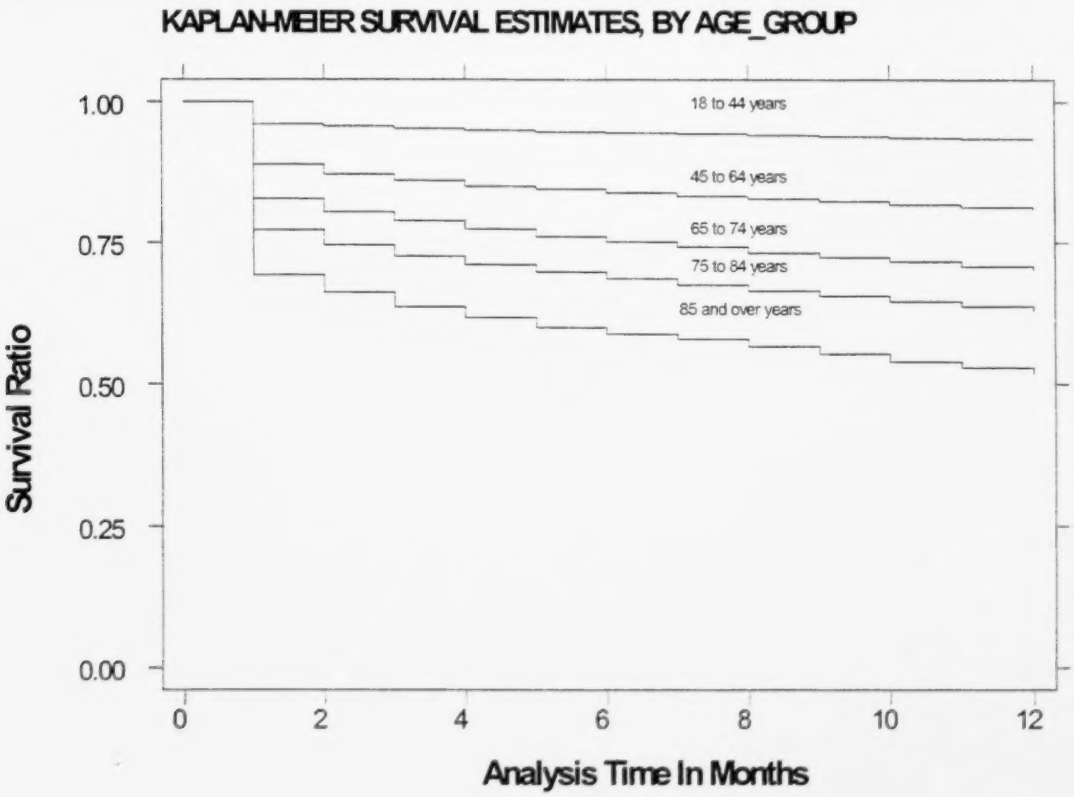

Figure 2 – Four-year survival for incident pneumonia cases alive at time of hospital discharge during 1994/95 only compared to age-specific general Alberta population

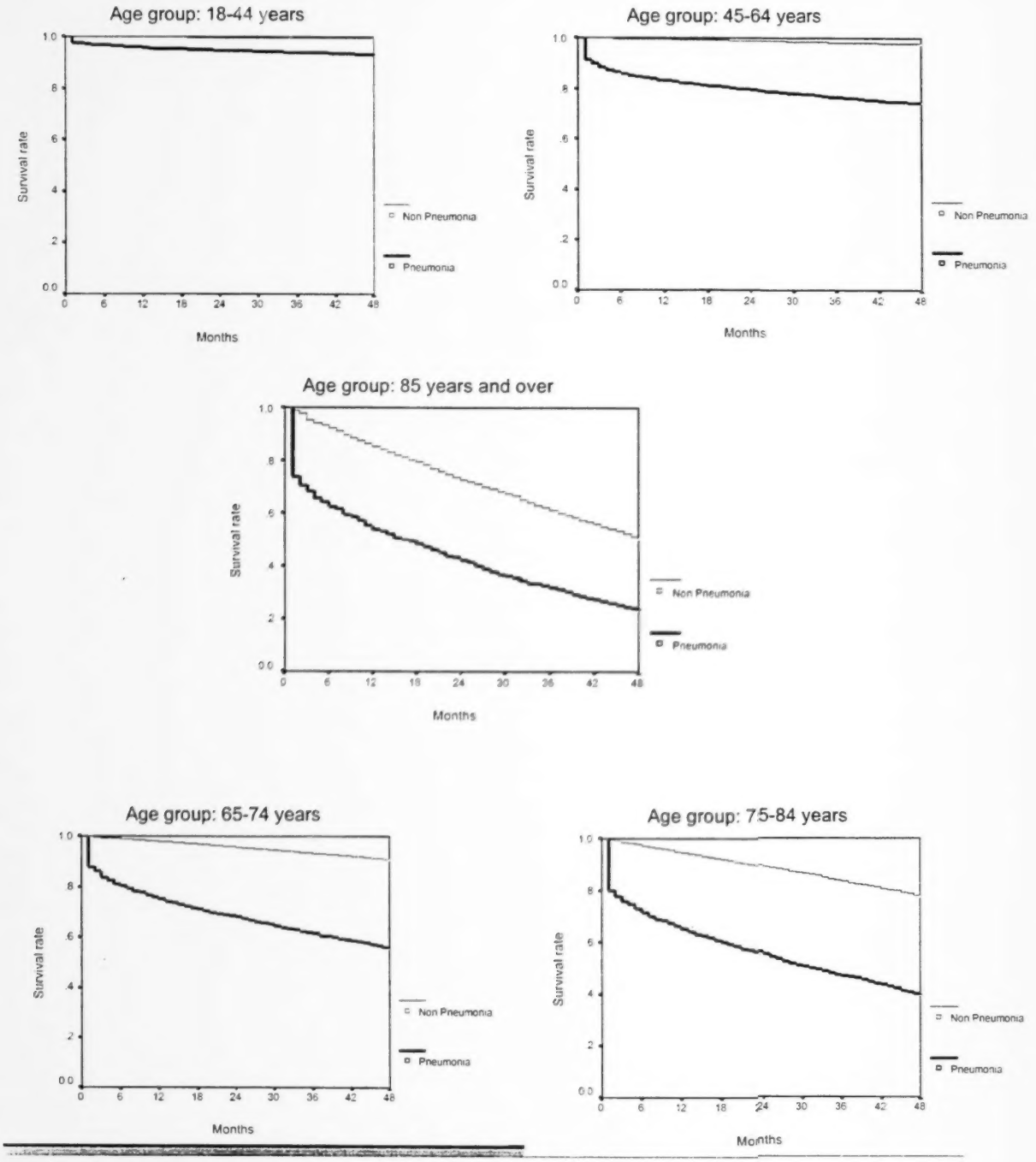

Figure 3 – Yearly composition of total hospital separations by age-specific group

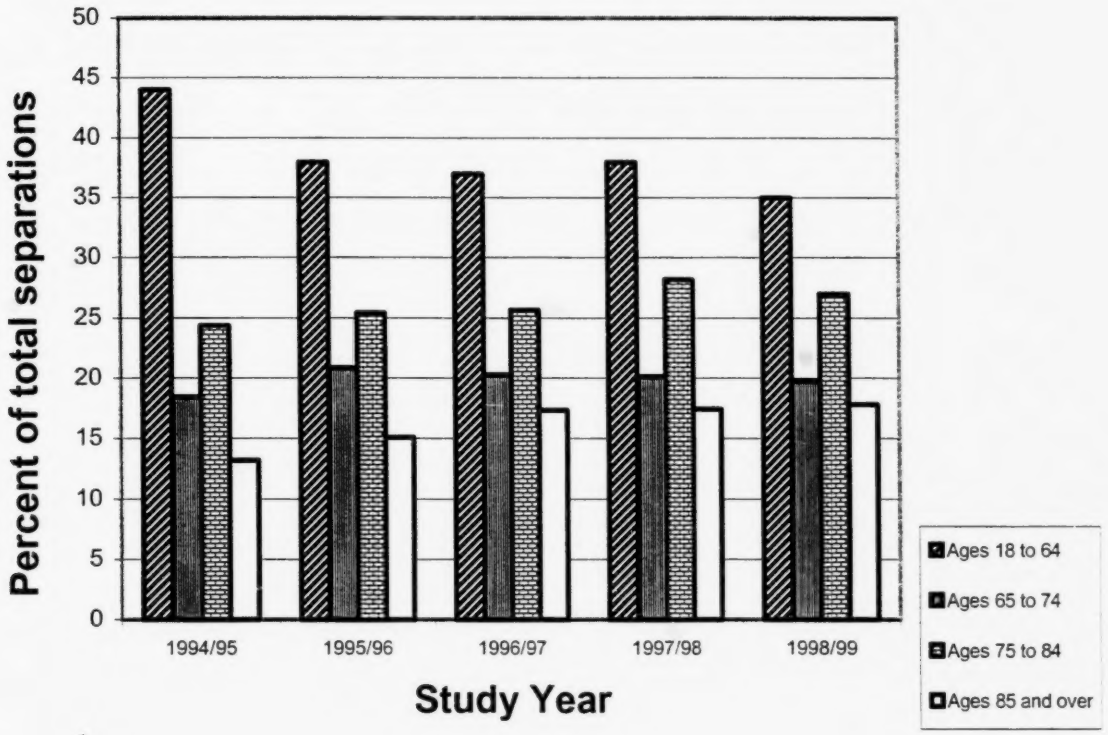

Table 3 – Multiple logistic regression for hospital deaths

	Odds ratio	95 % Confidence Interval
Respiratory failure/arrest	5.09	4.22 - 6.14
Comorbidity (0)	Reference	
Comorbidity (1)	2.50	2.06 - 3.04
Comorbidity (2)	4.16	3.39 - 5.10
Comorbidity (>2)	6.34	5.12 - 7.85
Hypotension/shock	4.08	3.13 - 5.33
Age 18 to 44 years	Reference	
Age 45 to 64 years	1.71	1.23 - 2.38
Age 65 to 74 years	2.18	1.58 - 3.00
Age 75 to 84 + years	3.30	2.42 - 4.50
Age 85 years and over	5.36	3.92 - 7.33
Aboriginal treaty status	0.14	0.07 - 0.30
Transfer from nursing home	1.95	1.55 - 2.45
Urban region of residence	1.45	1.15 - 1.82
Exported from home region	1.32	1.08 - 1.60
Rural hospitals (less than fifty cases per year)	Reference	
Rural hospitals (50 to 108 cases per year)	1.17	0.95 - 1.44
Regional hospitals	1.32	1.06 - 1.65
Urban hospitals (metropolitan)	0.93	0.72 - 1.20
Urban hospitals (in proximity to a medical school)	0.94	0.71 - 1.25
Female	0.87	0.78 - 0.98

Table 4 – Multiple logistic regression for one-year mortality

	Odds ratio	95 % Confidence Interval
Comorbidity (0)	Reference	
Comorbidity (1)	2.30	1.98 - 2.64
Comorbidity (2)	3.77	3.24 - 4.39
Comorbidity (>2)	4.79	4.02 - 5.69
Transfer from nursing home	3.43	2.73 - 4.31
Age 18 to 44 years	Reference	
Age 45 to 64 years	2.54	1.99 - 3.24
Age 65 to 74 years	3.05	2.40 - 3.88
Age 75 to 84 years	3.90	3.09 - 4.93
Age 85 years and over	6.18	4.86 - 7.85
Female	0.72	0.65 - 0.80
Aboriginal treaty status	0.48	0.36 - 0.64
Export from home region	1.45	1.24 - 1.69
Respiratory failure arrest	1.52	1.19 - 1.94
Per capital hospital beds	0.90	0.84 - 0.97
Hypotension/shock	1.51	1.07 - 2.13

Table 5 – Multiple linear regression for log of average daily hospital costs

	Relative Risk	95 % Confidence Interval
Age 18 to 44 years	Reference	
Age 45 to 64 years	0.85	0.81 - 0.89
Age 65 to 74 years	0.72	0.69 - 0.75
Age 75 to 84 years	0.64	0.62 - 0.67
Age 85 years and over	0.58	0.55 - 0.61
Female	0.90	0.88 - 0.93
Per capita hospital beds	0.95	0.94 - 0.97
Comorbidity (0)	Reference	
Comorbidity (1)	1.09	1.06 - 1.13
Comorbidity (2)	1.03	0.99 - 1.07
Comorbidity (>2)	0.95	0.90 - 1.00
Aboriginal treaty status	1.15	1.09 - 1.21
Rural hospitals (less than fifty cases per year)	Reference	
Rural hospitals (50 to 108 cases per year)	0.97	0.93 - 1.01
Regional hospitals	0.94	0.90 - 0.98
Urban hospitals (metropolitan)	0.97	0.94 - 1.01
Urban hospitals (in proximity to a medical school)	1.07	1.02 - 1.12
Transfer from nursing home	1.18	1.09 - 1.28
Respiratory arrest/failure	1.16	1.08 - 1.25

Table 6 – Multiple logistic regression for any special medical care

	Odds ratio	95 % Confidence Interval
Respiratory arrest/failure	11.68	9.34 - 14.59
Hypotension/shock	5.75	4.17 - 7.93
Rural hospitals (less than fifty cases per year)	Reference	
Rural hospitals (50 to 108 cases per year)	1.32	1.06 - 1.65
Regional hospitals	2.45	1.97 - 3.05
Urban hospitals (metropolitan)	1.22	1.00 - 1.50
Urban hospitals (in proximity to a medical school)	2.02	1.61 - 2.53
Comorbidity (0)	Reference	
Comorbidity (1)	1.06	0.90 - 1.25
Comorbidity (2)	1.35	1.11 - 1.64
Comorbidity (>2)	2.17	1.74 - 2.70
Age 18 to 44 years	Reference	
Age 45 to 64 years	1.12	0.92 - 1.36
Age 65 to 74 years	0.98	0.79 - 1.20
Age 75 to 84 years	0.72	0.58 - 0.88
Age 85 years and over	0.48	0.37 - 0.63
Exported from home region	1.52	1.28 - 1.81
Female	0.73	0.64 - 0.83

BIOGRAPHIES

Yan Jin, M.A.

B.Sc. Computer Sciences, Anhui University, China

M.A. Demography, University of Alberta, Canada

Project Consultant, Research and Evidence, Alberta Health and Wellness

As a demographer, Yan Jin is interested in applying demographic and statistical techniques in health field, particularly in population health and health service utilization. He has taught demographic techniques at the University of Alberta.

Contact Information:

Yan Jin, M.A.
Research and Evidence
Health Accountability
Alberta Health and Wellness
22 Floor, 10025 Jasper Avenue
Edmonton, Alberta
T5J 2N3
Phone: (780) 415-0210
Fax: (780) 422-2880
E-mail: yan.jin@gov.ab.ca

Thomas J. Marrie, M.D.

M.D., Dalhousie University

Professor of Medicine, University of Alberta

Chair, Department of Medicine, University of Alberta

Dr. Marrie's major research interest is in the area of community-acquired pneumonia. Over the years this focus has evolved from laboratory based research to a population health basis. Dr. Marrie's interest is in understanding the variation that occurs in the treatment of pneumonia and finding ways to minimize this variation.

Contact Information:

Thomas J. Marrie, M.D.
Professor and Chair, Department of Medicine
2F1.30 Walter Mackenzie Centre
8440 – 112 Street
Edmonton, Alberta
T6G 2B7
Phone: (780) 407-6234
Fax: (780) 407-3132
E-mail: tom.marrie@ualberta.ca

Keumhee C. Carrière, Ph.D.

Ph.D. in Statistics, Wisconsin-Madison, 1989

Professor of Statistics, University of Alberta, since 1996

Assistant Professor, University of Iowa, 1990 to 1992

Assistant Professor, University of Manitoba, 1992 to 1996

Director of Statistical Consulting Center, University of Iowa, 1990 to 1992

Dr. Carrière's areas of research include multivariate methods, design and analysis of repeated measures data, missing data, and multivariate Behrens-Fisher problems. Dr. Carrière's area of application is in health services research, where her contribution in this area led her to win the National Health Scholar Award (1996-2001) from the National Health Research and Development Program (NHRDP). She is a Senior Scholar with Alberta Heritage Foundation for Medical Research (AHFMR) (1999-2004) and is currently funded by the following organizations; NSERC, MRC, NHRDP, AHFMR, and NCIC.

Dr. Carrière is an elected board member of the Western North American Region of International Biometrics Society (2000-2002), a past member of its regional advisory board, and past elected executive member for the Section on Health Policy Statistics of the American Statistical Association (1999-2001). Dr. Carrière organized and chaired as well as invited and contributed paper sessions at major national and international conferences, including the recent Edmonton Statistics and Health conference in June 2000.

Contact Information:

Keumhee C. Carrière, Ph.D.
632 Central Academic Building
Department of Mathematical Sciences
University of Alberta
Edmonton, Alberta
T6G 2G1
Phone: (780) 492-4230
Fax: (780) 492-6826
E-mail: KC.Carriere@ualberta.ca

Gerry Predy, M.D.

M.D., University of Alberta

Fellowship in the Royal College of Physicians and Surgeons with a specialty in Community Medicine.

Medical Officer of Health, Capital Health Authority, since 1996

Over 25 years experience in Family Medicine and Public Health in both rural and urban settings.

Major responsibilities include managing health protection programs and monitoring and reporting on the health status of the population. Annually, Dr. Predy produces a health status report entitled "How Healthy Are We?" which makes use of population health indicators and the influence of the determinants of health.

Leading an initiative to address three priority issues in population health including heart disease/stroke, injury control and addressing the health needs of an aging population. Two additional priorities of low birth weight and healthy weights have been added recently.

Dr. Predy has a limited practice in a local medical clinic.

Contact Information:

Gerry Predy, M.D.
Public Health Division
Capital Health Authority
300, 10216 – 124 Street
Edmonton, Alberta
T5N 4A3
Phone: (780) 413-7600
Fax: (780) 413-7950
E-mail: gpredy@cha.ab.ca

Chris Houston, CCHRA(C)

Clinical Information Administrator, Clinical Performance Information and Research, Capital Health Authority

Ms. Houston's expertise is in clinical coding and grouping systems. Her areas of focus are coding quality and appropriate use of clinical information to ensure transformation of health data into best evidence to support decision making.

Contact Information:

Chris Houston, CCRHA(C)
Clinical Performance Information and Research
Capital Health Authority
9 Floor, 9925 – 109 Street
Edmonton, Alberta
T5K 2J8
Phone: (780) 413-7744
Fax: (780) 413-7783
E-mail: chouston@cha.ab.ca

Kathleen Ness, M.P.H.

M.P.H., Department Public Health Sciences, University of Minnesota

Adjunct Professor, Public Health Sciences, University of Alberta

Director, Clinical Performance, Information and Research, Capital Health Authority

In her current role, Kathleen Ness is responsible for Regional Quality and Utilization Reviews and Analysis, Regional Clinical Information Coordination, Health System Performance Reports and Regional Project Planning.

Kathleen interests are in moving research into policy decisions and actions, and the organizational processes and structures required to integrate research in health regions.

Contact Information:

Kathleen Ness, M.P.H.
Clinical Performance, Information and Research
Capital Health Authority
9 Floor, 9925 – 109 Street
Edmonton, Alberta
T5K 2J8
Phone: (780) 413-7739
Fax: (780) 413-7783
E-mail: kness@cha.ab.ca

David Johnson, M.D., S.M., M.B.A.

M.D., McGill University

S.M., Harvard University

M.B.A., University of Saskatchewan

Professor of Critical Care Medicine, University of Alberta

As a physician, Dr. David Johnson's clinical practice is affected by the health care system. Dr. Johnson is interested in understanding and promoting the use of information in directing health policy formation and decision making by the managers of the health care system.

Contact Information:

David Johnson, M.D., S.M., M.B.A.
Department of Critical Care Medicine
Faculty of Medicine
University of Alberta
Edmonton, Alberta
T6G 2B7
E-mail: cujecjohnson@shaw.ca

Summary of "Hospital Costs and Long Term Mortality Outcomes in Seniors Requiring Hospitalization for Community-Acquired Pneumonia in Alberta"

By K.C. Carrière , Y. Jin, T.J. Marrie, G. Predy, C. Houston, K. Ness, and D. Johnson

Purpose

This study describes the variation in outcomes (death and hospital costs) by age and special medical care provided for Albertans hospitalized with community acquired pneumonia.

Approach

Hospital discharges for community acquired pneumonia from April 1, 1994 to March 31, 1999 were analyzed using Alberta hospital abstracts and vital statistics. Special medical care was defined as transfer of an admitted patient to another acute care hospital, special or intensive care unit admission, use of a breathing machine for greater than ninety-six hours, or in-hospital dialysis.

Key findings

The following are the key findings of this study:

- There were 8,500 annual hospital discharges for community-acquired pneumonia costing over forty million dollars per year.
- The mean age of pneumonia cases increased from 62.8 years in 1994/95 to 67.2 years in 1998/99.
- The proportion of hospital separations in those eighty-five years and over was thirteen percent in 1994/95 increasing to eighteen percent in 1998/99.
- Special medical care occurred mostly in those aged eighty-four years or less nearly double the rate of these services received by patients in the eighty-five or over age group.
- The average length of hospital stay was nine days at a cost of $4,500.
- The overall in-hospital mortality rate was twelve percent and the one-year mortality rate was twenty-six percent.
- The four-year mortality for those patients hospitalized for pneumonia in the year 1994/95 is greater than that of the corresponding 1994/95 Alberta general population.
- The per capita rate for hospital use and length of hospital stay increased with age.
- After adjusting for other factors:
  - the relative risk of both in-hospital and one year mortality increased with age.
  - the relative risk for the use of special medical care and average daily hospital costs decreased with age.
  - having more other diseases was not associated with an increase in average daily hospital costs.

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Conclusions

The increased total costs of about $1,000 for hospital stay in those aged eighty-five or over compared to those aged eighteen to forty-four was consistent with competing costs due to an increased length of hospital stay and reduced use of special medical care. The anticipated marked increase in hospital resources because of an aging population may have been partially avoided because of the limitation of rendered therapy in the "old and frail".

Age-specific utilization rather than aging itself is a more important determinant of age-related increases in health expenditures. If the historical pattern of medical care choices continue, the anticipated increase in hospital costs for pneumonia care due to an aging population may be somewhat offset by the decreased utilization of special medical care in these oldest patients. However, choices about appropriate medical care vary over time, and, in future, an increased utilization of special medical care may occur in even the oldest patients. Such trends of increased utilization of health care services in an older population have already been noted for renal dialysis, organ transplantation, and coronary artery bypass surgery.

For more information

Copies of the report are available from the

Alberta Centre for Health Services Utilization Research

- by contacting David Johnson by e-mail at cujecjohnson@shaw.ca
- at http://www.health.gov.ab.ca/system/key/Research/achsur_reports.html

Alberta Centre for Health Services Utilization Research

The Alberta Centre for Health Services Utilization Research is a joint initiative between the University of Alberta and the University of Calgary, funded by Alberta Health and Wellness. The Centre conducts studies of how health services are used and delivered to inform health policy development and management of health services delivery.

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